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RESEARCH ARTICLE ARAŞTIRMA MAKALESİ

# SPECIES COMPOSITION AND DIVERSITY OF THE ZOOPLANKTON FAUNA OF DARLIK STREAM (İSTANBUL-TURKEY) AND ITS TRIBUTARIES

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**Abstract:** To determine zooplankton fauna of streams flowing into Darlık Reservoir, which supports important part of drinking water demand of Istanbul, zooplankton samples were monthly taken from 5 selected sampling stations between October 2008 and September 2010. The zooplankton community of the study area is composed of mainly Rotifera, Copepoda and Cladocera groups. During the study period a total of 39 *taxa* was observed, and 25 *taxa* of Rotifera, 7 *taxa* of Copepoda and 7 *taxa* of Cladocera were identified. Rotifera comprised 47.8%, Copepoda 43.9% and Cladocera 8.3% of the total zooplankton. The Shannon–Wiener diversity index values fluctuated in the range of 2.4 and 3.1 for stations. Zooplankton diversity index varied seasonally between 1.1-3.4. Generally, the higher values and higher temperature showed a higher zooplankton diversity indexes. In this study, also dissolved oxygen, conductivity, pH and water temperature were determined and results were determined at the suitable intervals for habitat choice of identified zooplankton species. All zooplankton species identified are the first record for the study area.

**Keywords:** Species, Composition, Seasonal distribution, Shannon-Wiener index, Zooplankton

This study is part of PhD thesis of Özcan GAYGUSUZ entitled "The Bioecological Features of Two Dominant Species of Cyprinidae in Some Streams of Darlık Dam Lake".

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**Özet:**

## Darlık Deresi ve Kollarının (İstanbul-Turkey) Zooplankton Faunasının Tür Kompozisyonu ve Çeşitliliği

İstanbul'un içme suyu ihtiyacının önemli bir kısmını karşılayan Darlık Baraj Gölü'ne akan derelerin zooplankton faunasını belirlemek amacıyla, Ekim 2008-Eylül 2010 tarihleri arasında, seçilen 5 istasyonda aylık periyotlar şeklinde örnekleme yapılmıştır. Çalışma alanının zooplankton kommunitesi başlıca Rotifer, Kopepod ve Kladoser gruplarından oluşmuştur. Çalışma süresince 25'i Rotifer, 7'si Kopepod ve 7'si Kladoser'e ait olmak üzere toplam 39 *taxa* tanımlanmıştır. Toplam zooplanktonun % 47.8'ini Rotifer, % 43.9'unu Kopepoda ve % 8.3'ünü Kladoser oluşturmuştur. Shannon-Wiener çeşitlilik indeksi istasyonlar için 2.4-3.1; mevsimsel olarak 1.1-3.4 arasında tespit edilmiştir. Genel olarak yüksek değerler, zooplankton bolluğu ve sıcaklığın artış gösterdiği durumlarda tespit edilmiştir. Çalışmada ayrıca çözünmüş oksijen, elektriksel iletkenlik, pH ve su sıcaklığı parametreleri de belirlenmiş ve sonuçlar tespit edilen zooplankton türlerinin tercih ettikleri yaşam alanları için uygun aralıklarda belirlenmiştir. Tanımlanan tüm zooplankton türleri çalışma alanı için ilk kayıt niteliğindedir.

**Anahtar Kelimeler:** Tür, Kompozisyon, Mevsimsel dağılım, Shannon-Wiener indeks, Zooplankton

## Introduction

Water is the most important element for human life and is a limited resource contrary to popular belief. Zooplankton are an important link in the transformation of energy from producers to consumers (Sharma *et al*., 2010). Zooplankton plays a key role as efficient filter feeders on the phytoplankton and as a food source for other invertebrates, fish larvae and fish (Deksne *et al*., 2011). Zooplanktonic organisms are bioindicators of water quality and pollution degree because they are strongly influenced by environmental changes and responds quickly to alternations in locality quality (Gannon and Stemberger, 1978). Biodiversity has been described as the primary criterion ensures the continuity of the human race by ecologists. In aquatic ecosystems, declining of zooplankton diversity, which is second level of the food webs will affect superior trophic levels and as long as this situation continues, it causes species, habitat or even ecosystems loss, eventually leading negative consequences for human beings.

They are also a second important step of food chain, for changing the herbal products to animal protein. Zooplanktonic organisms creates food resources for fish, fish larvae and invertebrates in aquatic systems, therefore they provide a flow of energy through the food chain. Although many studies have been conducted about zooplankton in Turkish lentic waters, relatively few studies were conducted in lotic waters. By these researches, the rotifer fauna of Gümüldür Stream (Ustaoğlu *et al*., 1996), the rotifer and cladoceran fauna of Seyhan Stream (Göksu *et al*., 1997), the cladoceran and copepod fauna of Gümüldür Stream (Ustaoğlu *et al*.,1997), the zooplankton of the Streams of west Aegean Region (Balık *et al*., 1999), the zooplankton of Gediz River Delta (Ustaoğlu *et al*., 1999), the rotifer fauna and its seasonal variations of Fırat River (Saler *et al*., 2000), the rotifer fauna and its seasonal variations of Zıkkım Stream (Saler and Şen, 2001), the rotifer fauna of Asi River (Bozkurt *et al*., 2002), the zooplankton fauna of some rivers in Mediterranean Region (Ceyhan Nehri, Seyhan Nehri, Manavgat Nehri, Savrun Suyu, Keşiş Çayı) (Bozkurt, 2004), the Copepoda and Cladocera fauna of Asi River (Göksu *et al*., 2005), the Rotifera fauna of Euphrates River basin (Akbulut and Yıldız, 2005), Rotifer fauna of Seli Stream (İpek and Saler, 2008), the zooplankton fauna of Kars River (Özbay and Altındağ, 2009), zooplankton structure of Karaman Stream (Altındağ *et al*., 2009), zooplankton succession of the Asi River (Bozkurt and Güven, 2010) and Rotifera fauna of Zamantı River and Homurlu Stream (Kaya *et al*., 2010), the zooplankton fauna of Kürk Stream (Saler *et al*.,2011), the zooplankton fauna of Porsuk Stream (Kırkağaç *et al*.,2011), the zooplankton fauna of Yuvarlak Stream (Mis *et al*., 2011), the zooplankton fauna of Munzur River (Saler, 2011) and the zooplankton fauna of Görgüşan and Geban Stream (İpek and Saler, 2012) were determined.

Darlık Reservoir is an important source for the metropole because it suppliesmajor portion of the daily drinking water needs of Istanbul. Therefore, the aim of this paper was to determine the zooplankton fauna of the study area, where no previous relevant data were available.

## Materials and Methods

*Study area*

The study was conducted on Darlık Stream and its tributaries Hepçe and Değirmençayırı, which are the main sources of Darlık Reservoir. Darlık Reservoir was established on Darlık stream between 1986-1988, and it is one of the most important drinking water resources of İstanbul. Samples were collected at selected 5 stations on the streams. St.1, St.2 and St.5 were selected on the Darlık Stream from the mouth to the inner part of the stream. St.3 and St.4 were selected on the tributaries of Darlık Stream. St.1 is the nearest station to the reservoir and its deep structure is stony. It is surrounded by agricultural areas. Deep structure of the St.2 is muddy, sandy and stony. Submerged vegetation spreads largely in summer months. St.3 (Hepçe) is a small stream, which pass near Çengili Village. It has a stony and rocky deep. Submerged vegetation occurs abundantly in summer months. There are cold water resources in and nearby the stream. The stream is surrounded by agricultural and damaged forestry areas. St.4 (Değirmençayırı) is a stream, which pass through Değirmençayırı Village has stony and big rocks on bottom. There are houses, farming areas, animal shelters and one filling station around the stream. The deep structure of St.5 is composed of mostly big rocks and stones. Although there is no residential area around, it has agricultural fields. The sampling stations are shown in Figure 1.

*Sampling*

This study was carried out between 29 October 2008 and 16 September 2010, with monthly intervals. The obtained data were evaluated as seasonally. Five sampling stations were chosen in streams flowing into the Darlık Dam Lake (Fig. 1). Zooplankton was collected in each station by filtering 45 L of water through a plankton net with 55 µm mesh size, preserved with 4% formaldehyde solution immediately and then identified under a binocular microscope and counted under an inverted microscope. All the zooplankton densities are presented as number of individuals per liter (ind. $L^{-1}$) (Czerniawski and Pilecka-Rapacz, 2011). The following references were reviewed to identify the specimens: Dussart (1967, 1969), Koste (1978) and Margaritora (1983). During the sampling period, dissolved oxygen, conductivity, salinity, pH and water temperature were measured *in situ* using portable instruments (WTW 310i multiparameter).

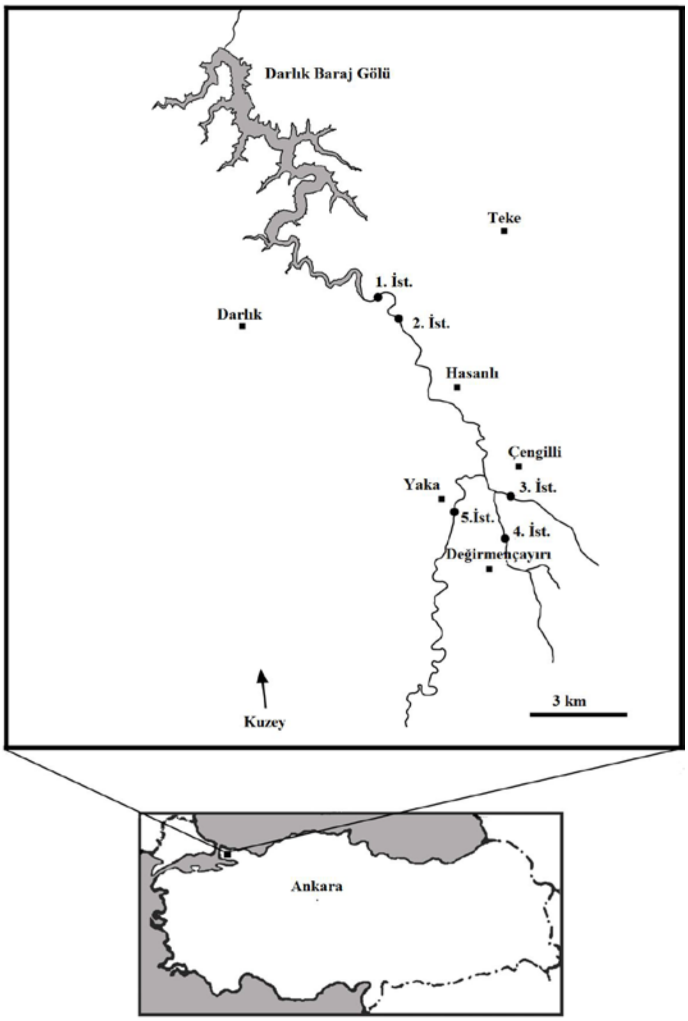


**Figure 1.** Study area and sampling stations.

*Data analysis*

For each zooplankton sample the Shannon-Wiener (1949) diversity index ($H'$) were calculated according to the following equation;

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

where $H'$ is the Shannon-Wiener diversity index, S is the number of species, p$i$ is the relative abundance of each species (p$i$= f$i$/n), f$i$ is the abundance of species $i$ and n is the total number of all individuals.

## Results and Discussion

In the present study the community structure and diversity of zooplankton and some environmental parameters investigated monthly in Darlık Stream and its tributaries Hepçe and Değirmençayırı, which are the main sources of Darlık Reservoir, during 29 October 2008 and 16 September 2010.

The water temperature fluctuated in the range of 5.6 °C in winter and 24.4 °C in summer (annual average of 14.2 °C). DO was measured with an annual average of 8.11 mg $L^{-1}$(min. 2.7 mg $L^{-1}$; max. 14.9 mg $L^{-1}$). The highest DO values were found in winter. pH values are on the alkaline side and varied between 7.1 and 8.8 (average 8.1). EC values ranged from 102.2 to 581.0 µmho $cm^{-1}$ with an annual average 358.7 µmho $cm^{-1}$. Chlorophyll *a* values alternated in the range of 0.11 µg $L^{-1}$ in winter and 91.02 µg $L^{-1}$ in autumn (annual average of 1.36 µg $L^{-1}$). Some physical and chemical parameters of water quality measured over two years (seasonally) study are given in Table 1. According to the Drinking Water Regulation by the Ministry of Forestry and Water Affairs (Anonymous, 2005), study area was found A2 water quality class by the determined parameters.

Zooplanktonic organisms are bioindicators of water quality and pollution degree because they are strongly influenced by environmental changes and responds quickly to alternations in locality quality (Gannon and Stemberger, 1978). Rotifers are more sensitive to environmental changes compared to other zooplankton groups and are used indicators of water quality (Gannon and Stemberger, 1978). Rotifers are commonly abundant in eutrophic freshwater ecosystems and are more abundant compared to other zooplankton groups (Herzig, 1987). Furthermore, Cladocerans and Cyclopoid Copepods are well adapted to eutrophic conditions (Gannon and Stemberger, 1978). Several authors reported on the importance of zooplankton in the efficiency of self-cleaning processes (Deksne, 2011). Zooplankton are an important link in the transformation of energy from producers to consumers (Sharma *et al*., 2010). Zooplankton plays a key role as efficient filter feeders on the phytoplankton and as a food source for other invertebrates, fish larvae and fish (Deksne, 2011). Consequently the zooplankton studies are quite important.

In lotic areas, true plankters often predominate and fast growing rotifers are often dominant. This may be a simple trophic effect or it may be that similar conditions favour both types of organism (Hynes 1970). Although water discharge is considered to be one of the main parameters affecting zooplankton seasonal variations in rivers (Saunders and Lewis 1988a,b, Brown *et al*. 1989, Pace *et al*. 1991, van Dijk and van Zanten 1995, Vranovsky 1995).

The zooplankton community of the study area is composed of mainly Rotifera and zooplanktonic Crustacea (Copepoda and Cladocera). During the study period a total of 39 *taxa* was observed, with 25 *taxa* of Rotifera, 7 *taxa* of Copepoda and 7 *taxa* of Cladocera identified (Table 2). Rotifera comprised 47.8%, Copepoda 43.9% and Cladocera 8.3% of the total zooplankton density (Fig. 2). Rotifera was the dominant group in study area. At the sampling stations, the number of zooplankton species was as herein defined; 19 *taxa* at station 1, 19 *taxa* at station 2, 13 *taxa* at station 3, 21 *taxa* at station 4 and 23 *taxa* at station 5 (Table 3). The number of species at the fifth station was higher than the other stations and the lowest number of species was at the third station. Most of the species were determined at all the stations throughout two years. However, *Colurella obtusa* and *Chydorus gibbus* were only found at St.1, *Euchlanis incisa*, *Pleuroxus aduncus* and *Paracyclops affinis* only at St.2, *Brachionus calyciflorus*, *Colurella colurus*, *Lecane (Monostyla) lunaris* and *Lepadella ovalis only* at St.4, and *Anuraeopsis fissa*, *Brachionus angularis*, *Monommata arndti*, *Platyias quadricornis*, *Trichocerca pusilla* and *Trichocerca similis grandis* only at St.5 (Table 3).

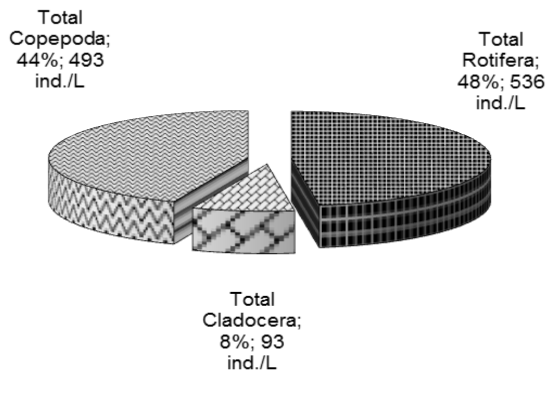


**Figure 2.** Percentage distribution of Total Zooplankton.

**Table 1.** Some physical and chemical parameters.

| Parameters | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **DO (mg/L)** | Min.- Max. | 3.29-14.5 | 3.63-12.9 | 2.7-14.9 | 4.73-12.4 | 3.18-14.9 |
| | Aver.± Stddev. | 8.2-3.0 | 8.3-2.8 | 8.1-3.0 | 8.8-2.5 | 8.1-3.4 |
| **pH** | Min.- Max. | 7.15-8.78 | 7.52-8.55 | 7.27-8.45 | 7.75-8.46 | 7.1-8.66 |
| | Aver.± Stddev. | 8.1-0.3 | 8.1-0.2 | 8.0-0.3 | 8.2-0.2 | 8.1-0.4 |
| **EC (µmho/cm)** | Min.- Max. | 129.6-479.7 | 132.3-571 | 153.1-537 | 186.7-488 | 102.2-581 |
| | Aver.± Stddev. | 339.9-115.0 | 336.6-121.3 | 384.3-129.1 | 403.9-97.8 | 289.5-139 |
| **W. Temp.(°C)** | Min.- Max. | 6.8-24.1 | 6.1-22.6 | 6.6-20.1 | 7.1-21.6 | 5.6-24.4 |
| | Aver.± Stddev. | 14.1-5.8 | 13.7-5.5 | 12.7-4.2 | 14.1-4.7 | 14.4-6.2 |
| **Chl *a* (µg $L^{-1}$)** | Min.- Max. | 0.11-4.884 | 0.11-6.216 | 0.11-1.332 | 0.11-3.996 | 0.222-91.02 |
| | Aver.± Stddev. | 1.3-1.2 | 1.4-1.6 | 0.5-0.3 | 0.9-0.9 | 7.0-20.0 |

**Table 2.** Classifications of the zooplankton species living in study area are as follows (Ustaoğlu, 2004).

**Phylum: Rotifera Cuvier, 1817**
**Classis: Eurotatoria De Ridder, 1957**
**Subclassis: Bdelloidea Hudson, 188**
**Ordo: Philodinida**
**Familia: Philodinidae Ehrenberg, 1838**
**Genus: Rotaria Scopoli, 1777**
*R. rotatoria* (Pallas, 1766)
**Subclassis: Monogononta Plate, 1889**
**Superordo: Pseudotocha Kutikova, 1970**
**Ordo: Ploimia Hudson & Gosse, 1886**
**Familia: Brachionidae Ehrenberg, 1838**
**Genus: Platyias Harring, 1913**
*P. quadricornis* (Ehrenberg, 1832)
**Genus: Brachionus Pallas, 1766**
*B. angularis* Gosse, 1851
*B. calyciflorus* Pallas, 1766
*B. diversicornis diversicornis* (Daday, 1883)
**Genus: Keratella Bory de St. Vincent, 1822**
*K. cochlearis* (Gosse, 1851)
**Genus: Anuraeopsis Lauterborn, 1900**
*A. fissa* Gosse, 1851
**Familia: Euchlanidae Ehrenberg, 1838**
**Genus: Euchlanis Ehrenberg, 1832**
*E. dilatata* Ehrenberg,1832
*E. incisa* Carlin,1939
*E. triquetra* Ehrenberg, 1838
**Familia: Lepadellidae Harring, 1913**
**Genus: Colurella Bory de St. Vincent, 1824**
*C. colurus* (Ehrenberg,1830)
*C. obtusa* (Gosse,1886)
*C. uncinata* (O.F.Müller,1773)
**Genus: Lepadella Bory de St. Vincent, 1826**
*L. ovalis* (O.F.Müller,1786)
**Familia: Lecanidae Remane, 1933**
**Genus: Lecane Nitzsch, 1827**

*L. (Monostyla) bulla* (Gosse, 1886)
*L. inermis* (Bryce,1892)
*L. luna* (O.F.Müller,1776)
*L. (Monostyla) lunaris* Ehrenberg, 1832
**Familia: Notommatidae Hudson & Gosse, 1886**
**Genus: Monommata Bartsch, 1870**
*M. arndti* Remane,1933
**Genus: Cephalodella Bory de St. Vincent, 1826**
*C. delicata* Wulfert, 1937
*C. gibba* (Ehrenberg,1838)
**Familia: Trichocercidae Harring, 1913**
**Genus: Trichocerca Lamarck, 1801**
*T. elongata tschadiensis* (Pourriot, 1968)
*T. pusilla* (Lauterborn,1898)
*T. similis grandis* Hauer, 1965
**Superordo: Gnesiotrocha Kutikova, 1970**
**Ordo: Flosculariacea Harring, 1913**
**Familia: Testudinellidae Harring, 1913**
**Genus: Pompholyx Gosse, 1851**
*P. sulcata* (Hudson,1885)
**Phylum: Arthropoda Latreille, 1829**
**Subphylum: Crustacea Brünnich, 1772**
**Classis: Branchiopoda Latreille, 1817**
**Subclassis: Phyllopoda Preuss, 1951**
**Ordo: Diplostraca Gerstaecker, 1866**
**Subordo: Cladocera Latreille, 1829**
**Infraordo: Anomopoda Stebbing, 1902**
**Familia: Daphniidae Sars, 1865**
**Genus: Daphnia O.F.Müller, 1785**
*D. longispina* O.F.Müller, 1875
**Familia: Chydoridae Stebbing, 1902**
**Subfamilia: Chydorinae Stebbing, 1902**
**Genus: Pleuroxus Baird, 1843**
*P. aduncus* (Jurine, 1820)
*P. trigonellus* (O.F.Müller,1785)
**Genus: Chydorus Leach, 1816**
*C. gibbus* Sars, 1891
*C. ovalis* Kurz, 1874
**Subfamilia: Aloninae Frey, 1967**
**Genus: Alona Baird, 1843**
*A. guttata* Sars, 1862
*A. rectangula* Sars, 1862
**Classis: Maxillopoda Dahl, 1956**
**Subclassis: Copepoda H.Milne-Edwards, 1840**
**Infraclassis: Neocopepoda Huys & Boxshall, 1991**
**Superordo: Podoplea Giesbrecht, 1882**
**Ordo: Cyclopoida Sars, 1918**
**Familia: Cyclopoidae G.O.Sars, 1913**
**Subfamilia: Eucyclopinae Kiefer, 1927**
**Genus: Macrocyclops Claus, 1893**

*M. albidus* (Jurine, 1820)

**Genus: Eucyclops Claus, 1893**

*E. macrurus* (G.O.Sars, 1863)

**Genus*: Paracyclops* Claus, 1893**

*P. affinis* (Sars, 1863)

**Genus: Diacyclops Kiefer, 1927**

*D. languidus* (G.O.Sars, 1863)

**Genus: Metacyclops Kiefer, 1927**

*M. gracilis* (Lilljeborg, 1853)

**Genus: Thermocyclops Kiefer, 1927**

*T. oithonoides* (Sars, 1863)

**Ordo:Harpacticoida Sars, 1911**

**Familia: Canthocamptidae Sars, 1906**

**Genus: Canthocamptus Westwood, 1836**

*C. staphylinus* (Jurine, 1820)

Among the identified species, *Keratella cochlearis*, *Rotaria rotatoria* (Pallas, 1766), *Alona rectangula*, *Daphnia longispina*, *Canthocamptus staphylinus*, *Diacyclops languidus* and *Eucyclops macrurus* were determined in zooplankton almost always during the sampling period (Table 3.). The dominant Rotifer in the study area was *K. cochlearis*. As for crustacean zooplankton, Cladocerans *Alona* spp. and *D. longispina*, and the copepod *Thermocyclops oithonoides* were dominant (Table 3.). The lowest number of zooplankton were observed in winter and spring. In winter, 9 zooplankton *taxa* were recorded, and the dominant zooplankton *taxa* were the Rotifer *K. cochlearis*, the cladoceran *Alona guttata* and the Copepoda *E. macrurus*. 9 zooplankton *taxa* were recorded in spring. The dominant zooplankton *taxa* were *K. cochlearis* again, the Cladoceran *D. longispina* and the harpacticoid copepod *C. staphylinus*. Seasonally, the highest number of zooplankton were observed in summer and autumn (335 ind. $L^{-1}$ and 526 ind. $L^{-1}$, respectively). In summer 27 *taxa* were recorded. Copepoda was the dominant group in summer and autumn (61.5% and 52.47% of total zooplankton, respectively). The dominant *taxa* during summer were *E. macrurus* and *D. languidus* of copepoda, and the cladocerans *A. guttata* and *D. longispina*, and the rotifer *A. fissa*. 26 *taxa* were recorded in autumn. The dominant *taxa* of zooplankton were determined *K. cochlearis, T. oithonoides* and *A. rectangula* as Rotifera, Copepoda and Cladocera, respectively.

Evaluating all 4 seasons and 5 stations of the study, the dominant *taxa* were the Rotifers *K. cochlearis* (28.7%), *R. rotatoria* (4.46%) and *A. fissa* (3.48) , the Cladocerans *A. guttata* (3.74%) and *D. longispina* (2.50%), and the copepods *T. oithonoides* (15.06%), *D. languidus* (10.61%) and *E. macrurus* (9.98%). Seasonal variation (ind. $L^{-1}$) depending on the stations in the main zooplankton groups (Rotifera, Copepoda and Cladocera) is given in Figure 3 and the seasonal distribution of the zooplankton of the streams is given in Table 3.

Studies conducted on the lotic waters of Turkey are given in introduction. Common species in other study areas and present study shown in Table 4. In present study, identified species *Brachionus diversicornis diversicornis*, *Cephalodella delicata*, *Euchlanis triquetra*, *Trichocerca elongata tschadiensis*, *T. similis grandis*, *Chydorus ovalis*, *P.affinis* and *T. oithonoides* were not reported for zooplankton of Turkish inland waters by Ustaoğlu (2004). Also *B.diversicornis diversicornis, C. delicata, E.incisa, E. triquetra, Lecane inermis, M. arndti, T. elongata tschadiensis, T. pusilla, T. similis grandis, C. gibbus, C. ovalis, D. languidus, E. macrurus, M. gracilis, P. affinis* and *T. oithonoides* were not reported from the other studied lotic areas since 2004 of Turkey (Table 4).

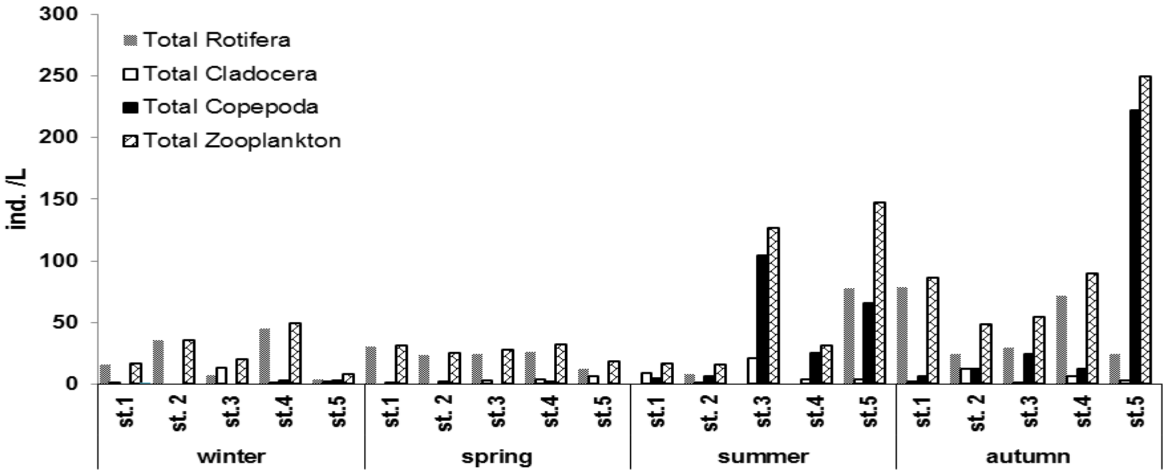


**Figure 3.** Seasonal distribution of zooplankton groups (Total Rotifera, Total Copepoda, Total Cladocera) and Total Zooplankton number (org. $L^{-1}$) in study area.

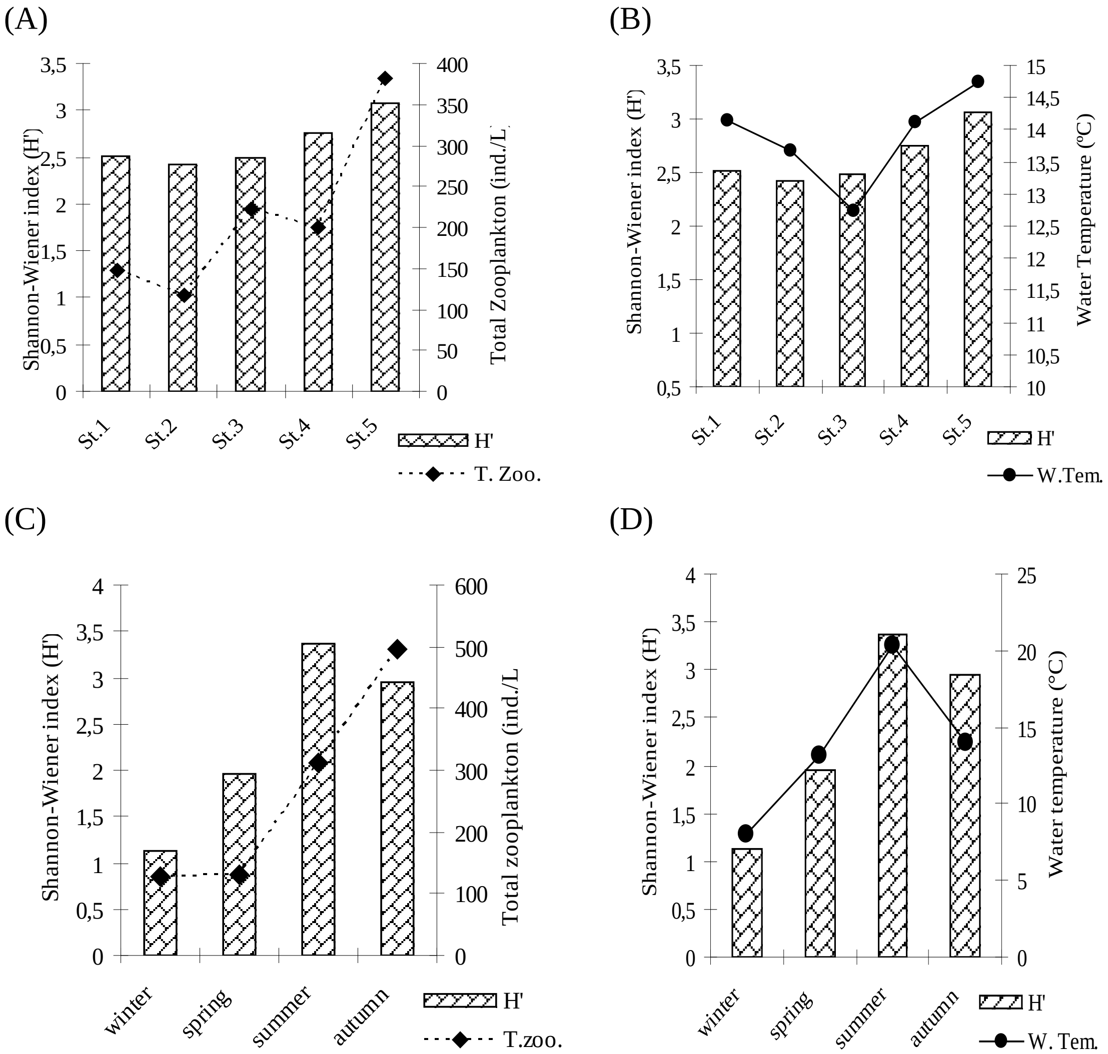


**Figure 4.** The relationship between Shannon–Wiener diversity indexes for the zooplankton community of the study area and total zooplankton (ind. $L^{-1}$) and water temperature (ºC) to stations (A,B) and seasons (C,D)

Most of the defined *taxa* (*B. angularis*, *B. calyciflorus, E. dilatata, K. cochlearis, L. bulla, L. ovalis* and *A. rectangula*) are cosmopolitan, and they were reported that they can be found in aquatic macro-vegetation (Bozkurt ve Güven, 2010). Furthermore, some species belonging to the genera *Lecane*, *Lepadella* and *Cephalodella* are littoral-periphytic forms (Bekleyen, 2001). Member of *Lecane*, *Lepadella*, *Colurella* and *Trichocerca* genus are able to adapt to various physical and chemical environments (Koste, 1978). *Keratella*, *Brachionus* and *Trichocerca* species are usually reported as dominant zooplankton *taxa* of lotic areas (Altındağ and Özkurt, 1998; Bekleyen, 2001; Altındağ and Yiğit, 2002; Tellioğlu and Şen, 2002; Güher, 2003). Among the identified species, *K. cochlearis*, *Trichocerca* spp., *Brachionus* spp. and *A. fissa* are well-known indicators of eutrophy (Sladeck, 1983; Kolisko, 1974). However, high abundance of these *taxa* were determined only some stations, when the water temperature was ascended. Among the identified species of the Cladocera group *P.aduncus* and *D. longispina* and of the Rotifera group *Euchlanis dilatata*, *P. quadricornis*, *Lecane luna*, *Lecane bulla* are among the species characteristic of eutrophic waters (Berzins and Bertilson, 1989; Apaydın Yağcı and Ustaoğlu, 2012). *B. angularis and B. calyciflorus* are characteristic species of alkaline waters (Koste, 1978). *D. languidus* is a littoral species, and do also occur in groundwater. This species was determined dominant copepod in summer at St.3, which is cold water resources in and nearby the stream. *E. macrurus* is most common in the macrophyte zone, it is acid sensitive and is one of the most common copepods in electrolyte rich environment with pH>7.0. Other dominant copepod species in summer was *E. macrurus*, and it was determined with dense vegetation at the St.3. *T. oithonoides* increases when surface area increases with rain. It has a relatively wide tolerance to pH (4.7-7.9) and electrolyte rich water to favourite. Therefore it was the dominant copepoda species in autumn at the St.5. *A. guttata* is a quite common littoral species. Differences in pH do not seem affect occurence of *A. guttata*, which has been found in localities with pH ranging from 3.9 to 9.9. frequency of records of *A. guttata* increase with increasing levels of electrolytes in the water. This species was found in summer at St.3, when the pH and EC values were increased.

Life cycles of zooplankters are related to the environmental factors (eg, water temperature, conductivity, pH, dissolved oxygen). Water temperature and dissolved oxygen values are the most important factors affecting the abundance of zooplankton (Park and Marshall, 2000). Water temperature is one of the most important parameter, which manages chemical and biological activity of organisms in aquatic life. Dissolved oxygen concentration reflects the dominating biological and physical processes in aquatic environments, and it is one of the most important parameter to determine the water quality. Physiology of zooplankters is under the influence of temperature, and especially the development of rotifer population is limited by the combined effect of DO concentration and temperature (Mikshi, 1989). In freshwater ecosytems, in aerobic conditions, the minimum dissolved oxygen value for aquatic life may not be less than 5.0 mg $L^{-1}$ (Kaya and Altındağ, 2007). In study area, dissolved oxygen value may sometimes be the limiting factor. The alteration of temperature affects the available nutrients in the environment, so it influences indirectly the abundance of zooplankton (Geller and Müller, 1981). Changes in temperature affect the metabolic rate of zooplankters, and especially is directly related to the reproduction of Cladocerans (Hebert, 1978). In the present study, the lowest total zooplankton abundance was determined in winter (128 ind. $L^{-1}$) at the lowest water temperature. The total zooplankton abundance was increased with the increase of temperature in spring (133 ind. $L^{-1}$) and summer (335 ind. $L^{-1}$). However, highest total abundance was recorded in autumn (526 ind. $L^{-1}$) with growing Rotifera and Copepoda densities. In autumn water cools and wind mixing restores nutrients, and phytoplankton sometimes increase in autumn. In the present study, the highest Chlorophyll *a* concentration was determined in summer and autumn. This situation changes the physical structure and plankton will cause seasonal variations. On the other hand, in autumn the value of fish eggs decrease significantly and adult of crustaceans starts to appear after these events. When fish juvenils are not abundant in the autumn, zooplankton biomass tend to be high. The lack of a relationship between zooplankton abundance and temperature in autumn, irrespective of the trophic state of the ecosystems during the autumn, may suggest a complex array of abiotic and biotic factors involved in zooplankton dynamics during that particularly variable period of the year. Also, increase of zooplankton abundance and growth of diversity of species can be explained by the river self-purification processes, in this stretch of the river favorable wastewater dilution area is built up with richly developed bacteria plankton, which is very good feeding base for the development of zooplankton. Determined higher abundance in autumn, thus, the low temperature that was present in this study might have affected organism metabolism, besides the increase of suspended solids and water velocity resulting from precipitation, among other factors. Most of the biological processes and biochemical reactions depends on pH, therefore it affects distribution of zooplankton, and in terms of pH alkaline limit was reported 8.5 (Berzins and Pejler, 1987). According to our results, pH values were determined on the alkaline side. Bozkurt and Sagat (2008) reported the acceptable value for aquatic organisms as 250-500 µmhos/cm (max. 2000 µmhos/cm). The conductivity variation can be an important regulator of the structure of zooplankton assemblages, especially species diversity and number of species (Williams, 1998). The mainly physicochemical conditions (water temperature, DO, pH, EC) of study area were found to be suitable for life cycle of identified zooplankton population.

The Shannon–Wiener diversity index of the *log*-transformed means of zooplankton species density of the study area showed similar values (2.4-3.1) during the study period for all stations (Fig. 4 A,B). Zooplankton diversity index varied between 1.1-3.4, seasonally (Fig. 4 C,D). Generally, the higher values and higher temperature showed a higher zooplankton diversity index (Fig. 4).

Changing physicochemical conditions affects the distribution and occurence of zooplankters directly or indirectly. The dynamics of the ecological attributes of zooplankton are well known in lakes and reservoirs in Turkey, however, few studies have been conducted in lotic environments. All physical, chemical and biological properties should be considered to understand the factors affecting the distribution of population (Sharma *et. al*., 2010).

## Conclusion

No study was previously carried out on the zooplankton fauna of study area, consequently it is not possible to follow the changes of zooplankton fauna in these streams. Present study, will be a base for the future studies in these streams and further to the acquirements of Turkey's biodiversity.

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## References

Akbulut Emir, N., Yıldız, K., (2005). The rotifera fauna of Euphrates of River Basin (Turkey), *Hacettepe Journal Biology and Chemistry*, **34**: 93-105.

Altındağ, A., Özkurt, Ş., (1998). A Study on the zooplanktonic fauna of the Dam Lakes Kunduzlar and Çatören (Kırka-Eskisehir), *Turkish Journal of Zoology*, **22**: 323-331.

Altındağ, A., Yiğit, S. (2002). The Zooplankton fauna of Lake Burdur, *EgeUniversity Journal of Fisheries and Aquatic Sciences*, **19**: 129-132.

Altındağ, A., Buyurgan, Ö, Kaya, M., Özdemir, E., Dirican, S., (2009). A Survey physico-chemical parameters and zooplankton structure in Karaman Stream, Antalya, Turkey, *Journal of Animal and Veterinary Advances*, **8**(9): 1710-1716.

Anonymous, (2005). Drinking water Regulation by the Ministry of Forestry and Water Affairs. Issued by Republic of Turkey, Ministry of Forestry and Water Affairs, Official Gazette no: 25999 (in Turkish).

Apaydın Yağcı, M., Ustaoğlu, M.R., (2012). Zooplankton fauna of Lake İznik (Bursa, Turkey), *Turkish Journal of Zoology*, **36**(3): 341-350.

**doi:10.3906/zoo-1001-36**

Balık, S., Ustaoğlu, M.R., Sarı, H.M., (1999). Kuzey Ege Bölgesi'ndeki akarsuların faunası üzerine ilk gözlemler, *EgeUniversity Journal of Fisheries and Aquatic Sciences*, **16**(3-4): 289-299.

Bekleyen, A., (2001). A Taxonomical study on the rotifera fauna of Devegeçidi Dam Lake (Diyarbakır-Turkey), *Turkish Journal of Zoology*, **25**: 251-255.

Berzins, B., Pejler, B., (1987). Rotifer occurence in relation to pH, *Hydrobiologia*, **147**: 107-116.

**doi: 10.1007/BF00025733**

Berzins, B., Bertilson, J., (1989). On limnic micro-crustacean and trophic degree, *Hydrobiologia*, **185**: 95-100. **doi: 10.1007/BF00010808**

Bozkurt, A., Göksu, M.Z.L., Sarıhan, E., Taşdemir, M., (2002). Asi Nehri Rotifer faunası (Hatay, Türkiye), *EgeUniversity Journal of Fisheries and Aquatic Sciences*, **19(1-2)**: 63-67.

Bozkurt, A., (2004). Preliminary observation on the Zooplankton fauna of some rivers in Mediterranian Region, *Turkish Journal of Aquatic Life*, **3**: 65-70.

Bozkurt, A., Sagat, Y., (2008). Birecik Baraj Gölü zooplanktonunun vertikal dağılımı, *Journal of FisheriesSciences.com*, **2(3):** 332-342.

**doi: 10.3153/jfscom.mug.200721**

Bozkurt, A., Güven, S.E., (2010). Zooplankton succession of the Asi River (Hatay-Turkey), *Journal of FisheriesSciences.com*, **4**(4): 337-353.

**doi: 10.3153/jfscom.2010037**

Brown, A.V., Limbeck, R.L., Schram, M.D., (1989) Trophic importance of zooplankton in streams with alluvial riffle and pool geomorphometry, *Archiv für Hydrobiologie*, **114**: 349-367.

Czerniawski R., Pilecka-Rapacz M., (2011) Summer zooplankton in small rivers in relation to selected conditions, Central European Journal of Biology, **6**(4): 659-674.

**doi: 10.2478/s11535-011-0024-x.**

Deksne, R., (2011). Influence of wastewater on zooplankton community of the Daugava River after Daugavpils wastewater treatment plant modernization. Environment. Technology. Resources Proceedings of the 8th International Scientific and Practical Conference. Volume 1, Rēzeknes Augstskola, Rēzekne, RA Izdevniecība, ISSN 1691-5402, ISBN 978-9984-44-070-5.

Dussart, B., (1967). Les Copépodes Des Eaux Continentales D'Europe Occidentale, Tome I Calanoides et Harpacticoides, Ed: N.Boubée and Cie 3, Place Saint-André-des-Arts, Paris 6º.

Dussart, B., (1969). Les Copépodes Des Eaux Continentales D'Europe Occidentale, Tome II Cyclopoides et Biologie, Ed: N.Boubée and Cie 3, Place Saint-André-des-Arts, Paris 6º.

Gannon, J.E., Stemberger, R.S., (1978). Zooplankton (Especially Crustaceans and Rotifers) as indicators of water quality, *Transactions of the American Microscopical Society*, **97**(1): 16-35.

**doi: 10.2307/3225681**

Geller, W., Müller, H., (1981). The filtration apparatus of Cladocera: filter mesh-sizes and their implications on food selectivity, *Oecologia*, **49**: 316-321.

**doi: 10.1007/BF00347591**

Göksu, L., Çevik, F., Bozkurt, A., Sarıhan, E., (1997). Seyhan Nehri'nin (Adana il merkezi sınırları içindeki bölümünde) rotifera ve cladocera faunası, *Turkish Journal of Zoology*, **21**: 439-443.

Göksu, M.Z.L, Bozkurt, A., Taşdemir, M., Sarıhan, E., (2005). Asi Nehri (Hatay, Türkiye) Cladocera ve Copepoda (Crustacea) faunası, *Ege University Journal of Fisheries and Aquatic Sciences*, **22(1-2)**:17-19.

Güher, H., (2003). Mert, Erikli, Haman ve Pedina Göllerinin (İğneada/Kırklareli) zooplanktonik organizmalarının kommunite yapısı. *EgeUniversity Journal of Fisheries and Aquatic Sciences*, **20(1-2)**: 51-62.

Hebert, P.D., (1978). Cyclomorphosis in natural populations of *Daphnia cephalata* King, *Freshwater Biology*, **8**: 79-90.

**doi: 10.1111/j.1365-2427.1978.tb01429.x**

Herzig, A., (1987). The analysis of planktonic rotifer population: A plea for long-term investigations. *Hydrobiologia*, **147**: 163-180.

**doi: 10.1007/BF00025739**

Hynes, H. B. N., (1970). The Ecology of Running Waters. Liverpool University Press. 555 pp.

İpek, N., Saler, S., (2008). Seli Çayı (Elazığ, Türkiye) Rotifer faunası ve bazı biyoçeşitlilik indeksleri ile analizi, *Ege University Journal of Fisheries and Aquatic Sciences*, **25**(3): 211-215.

İpek, N., Saler, S., (2012). Zooplankton of Gorgusan Stream and Geban Stream (Elazıg-Turkey), *Journal of FisheriesSciences.com,* **6(2)**: 155-163.

**doi:** 10.3153/jfscom.2012019

Kaya, M., Altındağ, A., (2007). Zooplankton fauna and seasonal changes of Gelingüllü Dam Lake (Yozgat, Turkey), *Turkish Journal of Zoology,* **31**: 347-351.

Kaya, M., Fontaneto, D., Segers, H., Altındağ, A., (2010). Temperature and salinity as interacting drivers of species richness of planktonic rotifers in Turkish continental waters, *Journal of Limnology*, **69**(2): 297-304.

**doi:** 10.3274/JL10-69-2-11

Kırkağaç, M.U., Demir, N., Topçu, A., Fakıoğlu, Ö., Zencir, Ö., (2011). An Investigation on aquatic macrophytes, zooplankton and benthic macroinvertebrates in Porsuk River (Eskişehir), *Ankara Üniversitesi Çevrebilimleri Dergisi*, **3**(1): 65-72.

Kolisko, R.A., (1974). Plankton Rotifers Biology and Taxonomy. Biological Station Lunz of the Austrian Academy of Science, Stuttgart.

Koste, W., (1978). Rotatoria. Die Rädertiere Mitteleuropas. Ein Bestimmungswerk, Begründet von Max, Voigt Überordnung Monogononta, Gebraider Borntraeger Berlin Stuttgart.

Margaritora, F., (1983). Cladoceri (Crustacea: Cladocera), Guide Per IL Riconoscimento Delle Specie Animali Delle Acque Interne Italiane 22. Consiglio Nazionale Delle Ricerche AQ/1/197, Verona, Italy.

Mikshi, E., (1989). Rotifer Distributions in relation to temparature and oxygen content, *Hydrobiologia*, **186/187**: 209-214.

**doi:** 10.1007/BF00048914

Mis, D.Ö., Aygen, C., Ustaoğlu, M.R., Balık, S., (2011). The Zooplankton fauna of Yuvarlak Stream (Köyceğiz-Muğla), *Turkish Journal of Fisheries and Aquatic Sciences,* **11**: 661-667.

**doi:** 10.4194/1303-2712-v11_4_21

Özbay H., Altındag, A., (2009). Zooplankton abundance in the River Kars, Northeast Turkey: Impact of environmental variables, *African Journal of Biotechnology*, **8**(21): 5814-5818.

Pace, M.L., Findlay, S.E.G., Lints, D., (1991) Zooplankton in advective environments: The Hudson river community and a comparative analysis, *Canadian Journal of Fisheries and Aquatic Sciences,* **49**: 1060-1069.

**doi:** 10.1139/f92-117

Park, G.S., Marshall, H.G., (2000). The Trophic contributions of Rotifers in tidal freshwater and estuarine habitats, *Estuarine, Coastal and Shelf Science,* **51**: 729-742.

**doi:** 10.1006/ecss.2000.0723

Saler, S.E., Şen, B., Şen, D., (2000). Fırat Nehri'nin Kömürhan Bölgesi Rotiferleri (Rotatoria; Aschelmintes) ve mevsimsel değişimleri. *Su Ürünleri Sempozyumu*, 20-22 Eylül, 385-396, Sinop.

Saler, S.E., Şen, B., (2001). Hazar Gölü'ne Dökülen Zıkkım Deresi'nin (Elazığ) Rotiferleri ve Mevsimsel Değişimleri. *XI. Ulusal Su Ürünleri Sempozyumu*, 04-06 Eylül, 261-271, Hatay.

Saler, S., İpek, N., Aslan, S., (2011). Zooplankton of Kurk Stream (Elazig-Turkey), *Journal of FisheriesSciences.com,* **5**(3): 219-225.

**doi:** 10.3153/jfscom.2011026

Saler, S., (2011). Zooplankton of Munzur River (Tunceli-Turkey), *Journal of Animal and Veterinary Advances,* **10**(2): 192-194.

**doi:** 10.3923/javaa.2011.192.194

Saunders, J.F., Lewis, W.M., (1988a). Zooplankton abundance in the Caura river, Venezuela, *Biotropica,* **20**: 206-214.

**doi:** 10.2307/2388235

Saunders, J.F., Lewis, W.M. (1988b). Zooplankton abundance and transport in a tropical white-water river, *Hydrobiologia*, **162**: 147-155.

**doi: 10.1007/BF00014537**

Shannon, C.E., Weaver, W., (1949). The Mathematical theory of communication. The University of Illinois Press, Urbana, IL.

Sharma, S., Siddique, A., Singh, K., Chouhan, M., Vyas, A., Solnki, C.M., Sharma, D., Nair, S., Sengupta, T., (2010). Population dynamics and seasonal abundance of zooplankton community in Narmada River (India), *Researcher*, **2**(9): 1-9.

Sladeck, V., (1983). Rotifers as indicators of water quality, *Hydrobiologia*, **100**: 169-201.

**doi: 10.1007/BF00027429**

Tellioğlu, A., Şen, D., (2002). Hazar Gölü (Elazığ) rotifer faunasının taksonomik yönden incelenmesi, *Ege University Journal of Fisheries and Aquatic Sciences*, **19**: 205-207.

Ustaoğlu, M.R., Balık, S., Aygen, C., Özdemir, D. (1996). Gümüldür Deresi'nin (İzmir) Rotifer faunası, *Ege University Journal of Fisheries and Aquatic Sciences*, **13**(1-2): 163-169.

Ustaoğlu, M.R., Balık, S., Özdemir, D., Aygen, C., (1997). Gümüldür Deresi'nin (İzmir) Cladocera ve Copepoda Faunası, *IX. Ulusal Su Ürünleri Sempozyumu*, 17-19 Eylül, 291-299, Eğirdir, Isparta.

Ustaoğlu, M.R., Özdemir Mis, D., Aygen, C., (1999). İçsu Zooplanktonu. In: Sulak alanların yönetimi projesi, Gediz Deltası sulak alan yönetim planı alt projesi. Final raporu, Çevre Bakanlığı, Çevre Koruma Genel Müdürlüğü, Proje No: 97K100020, Ankara: 263-274.

Ustaoğlu, M.R., (2004). A Check-list for zooplankton of Turkish inland waters, *EgeUniversity Journal of Fisheries and Aquatic Sciences*, **21**(3-4): 191– 199.

van Dijk, G.M., van Zanten, B., (1995). Seasonal changes in zooplankton abundance in the lower Rhine during 1987-1991, *Hydrobiologia*, **304**: 29-38.

**doi: 10.1007/BF02530701**

Vranovsky, M., (1995). The effect of current velocity upon the biomass of zooplankton in the river Danube side arms, *Biologia Bratislava*, **50**: 461-464.

Williams, W.D., (1998) Salinity as a determinant of the structure of biological communities in salt lakes, *Hydrobiologia*, **381**: 191-201.

**doi: 10.1023/A:1003287826503**

**Table 3.** Seasonally distribution of zooplankton species in each station in study area.

| | **Season** | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Winter | | | | | Spring | | | | | Summer | | | | | Autumn | | | | |
| | **Station** | | | | | | | | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| **Rotifera** | | | | | | | | | | | | | | | | | | | | |
| *A. fissa* | | | | | | | | | | | | | | | + | | | | | |
| *B. angularis* | | | | | | | | | | | | | | | + | | | | | |
| *B. calyciflorus* | | | | | | | | | | | | | | + | | | | | | |
| *B. diversicornis diversicornis* | | | | | | | | | | | | + | | | + | | | | | |
| *C. delicata* | | | | | | | | | | | | + | | | | | | | | |
| *C. gibba* | | | | | | + | | | + | + | | | | | | | | + | | |
| *C. colurus* | | | | | | | | | | | | | | + | | | | | | |
| *C. obtusa* | | | | | | | | | | | + | | | | | | | | | |
| *C. uncinata* | | | | | | | | | + | | | | | | | + | | | | |
| *E. dilatata* | | | | | | | + | | + | | | | | | | + | + | + | + | + |
| *E. incisa* | | | | | | | | | | | | | | | | | + | | | |
| *E. triquetra* | | | | | | + | + | | + | + | | | | | | | | | + | |
| *K. cochlearis* | + | + | + | + | + | + | + | + | + | + | | + | | | + | + | + | + | + | + |
| *L. (M.) bulla* | | | + | | | | | | | | | + | | | + | + | | + | | |
| *L. inermis* | | | | | | | | | | | | | | | | + | | + | + | |
| *L. luna* | | | | | | | | | | | | | | | | + | | | + | |
| *L. (M.) lunaris* | | | | | | | | | | | | | | | | | | | + | |
| *L. ovalis* | | | | | | | | | | | | | | | | | | | + | |
| *M. arndti* | | | | | | | | | | | | | | | + | | | | | |
| *P. quadricornis* | | | | | | | | | | | | | | | | | | | | + |
| *P. sulcata* | | | | | | | | | | | | + | | | + | | | | | |
| *R. rotatoria* | | + | | | | + | + | + | + | + | + | + | + | | | + | + | + | + | + |
| *T. elongata tschadiensis* | | | | | | | | | | | | | | | | + | | + | | |
| *T. pusilla* | | | | | | | | | | | | | | | + | | | | | |
| *T. similis grandis* | | | | | | | | | | | | | | | + | | | | | |
| **Cladocera** | | | | | | | | | | | | | | | | | | | | |
| *A. guttata* | | | + | + | | | | + | | | | | + | | | | + | | | |
| *A. rectangula* | + | | | | | | | | | | | | | + | | + | + | + | + | + |
| *C. gibbus* | | | | | | | | | | | + | | | | | | | | | |
| *C. ovalis* | | | | | | | | | | | | | | | + | | + | | | + |
| *D. longispina* | | | | | + | | | | + | + | + | + | + | + | + | | | | | + |
| *P. aduncus* | | | | | | | | | | | | | | | | | + | | | |
| *P. trigonellus* | | | | | | | | | | | + | | | | | | + | | | |
| **Copepoda** | | | | | | | | | | | | | | | | | | | | |
| *C. staphylinus* | | | | | + | + | + | | + | | + | | | | | | | | | + |
| *D. languidus* | | | | + | | | | | | | | | + | + | + | | + | + | + | + |
| *E. macrurus* | | | | + | + | | | | | | | + | + | + | + | | + | + | + | + |
| *M. albidus* | | | | | | | | | | | | | + | | | | | | | + |
| *M. gracilis* | | | | | | | | | | | + | | | + | + | + | | | | |
| *P. affinis* | | | | | | | | | | | | + | | | | | | | | |
| *T. oithonoides* | | | | | | | | | | | + | | | | | + | | | + | + |

**Table 4.** Common species with other study areas in Turkey.

| Species | Stations 1 | 2 | 3 | 4 | 5 | Common species with other study areas* |
|---|---|---|---|---|---|---|
| **Rotifera** | | | | | | |
| *A. fissa* | | | | | + | 7 |
| *B. angularis* | | | | | + | 1, 7, 8, 9, 10, 11, 14, 15 |
| *B. calyciflorus* | | | | + | | 1, 7, 10, 12, 14, 16 |
| *B. diversicornis diversicornis* | | + | | | + | - |
| *C. delicata* | | + | | | | - |
| *C. gibba* | + | | + | + | + | 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 14, 15, 16 |
| *C. colurus* | | | | + | | 6, 8, 12 |
| *C. obtusa* | + | | | | | 8, 12, 14 |
| *C. uncinata* | + | | | + | | 12 |
| *E. dilatata* | + | + | + | + | + | 1, 2, 3, 4, 5, 8, 10, 14, 15, 16 |
| *E. incisa* | | + | | | | - |
| *E. triquetra* | + | + | | + | + | - |
| *K. cochlearis* | + | + | + | + | + | 1, 2, 6, 7, 8, 9, 11, 13, 14, 15, 16 |
| *L. (M.) bulla* | + | + | + | | + | 1, 2, 3, 4, 5, 7, 8, 12, 16 |
| *L. inermis* | + | | + | + | | - |
| *L. luna* | + | | | + | | 1, 2, 3, 4, 5, 7, 8, 12,15, 16 |
| *L. (M.) lunaris* | | | | + | | 1, 2, 3, 4, 5, 6, 7, 8, 12, 14, 15, 16 |
| *L. ovalis* | | | | + | | 1, 2, 3, 4, 6, 7, 13, 14, 16 |
| *M. arndti* | | | | | + | - |
| *P. quadricornis* | | | | | + | 4, 7, 16 |
| *P. sulcata* | | + | | | + | 1, 6 |
| *R. rotatoria* | + | + | + | + | + | 3, 7 |
| *T. elongata tschadiensis* | + | | + | | | - |
| *T. pusilla* | | | | | + | - |
| *T. similis grandis* | | | | | + | - |
| **Cladocera** | | | | | | - |
| *A. guttata* | | + | + | + | | 7, 12, 16 |
| *A. rectangula* | + | + | + | + | + | 1, 2, 5, 7, 12, 14, 15, 16 |
| *C. gibbus* | + | | | | | - |
| *C. ovalis* | | + | | | + | - |
| *D. longispina* | + | + | + | + | + | 1, 5, 9, 14, 15 |
| *P. aduncus* | | + | | | | 16 |
| *P. trigonellus* | + | + | | | | 16 |
| **Copepoda** | | | | | | - |
| *C. staphylinus* | + | + | | + | + | 16 |
| *D. languidus* | | + | + | + | + | - |
| *E. macrurus* | | + | + | + | + | - |
| *M. albidus* | | | + | | + | 5 |
| *M. gracilis* | + | | | + | + | - |
| *P. affinis* | | + | | | | - |
| *T. oithonoides* | + | | | + | + | - |

* 1: Ceyhan River, 2: Keşiş Stream, 3: Savrun Stream, 4: Deliçay, 5: Manavgat River, 6: Seyhan River, 7: Asi River, 8: Karaman Stream, 9: Kürk Stream, 10: Porsuk Stream, 11: Seli Stream, 12: Kars River, 13: Munzur River, 14: Gorgusan Stream, 15: Geban Creek, 16: Yuvarlak Stream.